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A Comparison of Scales and Fin Rays for Ageing Lake Trout in Five Southeastern Ontario Lakes

Rideau Lakes
Fisheries Assessment Unit
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ABSTRACT

We compared ages obtained using scales and fin rays from 452 lake trout angled from five southeastern Ontario lakes. Agreement between the two ageing methods declined with age; fin rays yielding higher values than scales except for young fish (i.e. <= 5 years). Results were similar for native and stocked fish.

In addition, we tested the validity of both ageing methods with a sample (158) of known aged stocked fish. Ages assigned using fin rays were generally greater than known ages while scales gave good agreement for known aged fish in the 6 to 9 year old age class.

We conclude that for lake trout in our five study lakes in southeastern Ontario, scales yield satisfactory age assessment for the age group 6 to 9 but recommend that otiliths be collected, when possible, to obtain more reliable ages for younger and older lake trout.

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1. INTRODUCTION

Age-structured population parameters used by fisheries managers, eg. mortality and year class strength, depend on accurate age assessment. Scales are the most widely used ageing structure and are Rideau Lakes Fisheries Assessment Unit's (RLFAU) routine method of lake trout age assessment.

Recently, the scale ageing method for lake trout has come under considerable scrutiny as a result of verification using other bony structures (Healey 1978, Ontario 1983). Investigators have shown differences in ages determined by scales and otiliths, especially for older fish (Dubois and Lagueux 1968, Power 1978). Nolting (unpublished, in Martin and Olver 1980) found good agreement up to age 5 between scales and branchiostegal rays. The Ontario Ministry of Natural Resources (MNR 1983) describes discrepencies involving a variety of bony structures including pectoral fin rays. They observed that scales yield inconsistent results for lake trout aged 6 to 10 and are unreliable for older fish but concluded that the scale ageing method is sufficiently reliable for heavily exploited populations containing young, rapidly growing, individuals. Swainson (1985) compared seven calcified structures and found that all methods except branchiostegal rays gave similar ages up to age 6 or 8 years. Otiliths were the structure most easily interpreted in older lake trout giving best agreement with partly known aged and known aged fish.

The lake trout populations in southeastern Ontario area are heavily exploited by the sport fishery (Hoyle and MacLean 1988). Furthermore, stomach content analysis reveals that these lake trout are primarily piscivorous (RLFAU unpublished data). Thus, growth rates are generally very rapid, ranging from about 90 to 130% of the Ontario 'average' (MNR 1983) for fish aged 6 and 7 (Hoyle and MacLean 1988).

Here, we compare our scale ages with ages obtained using fin rays from 452 lake trout collected during winter creel surveys on five RLFAU lakes in 1986. Further, we test the validity of both ageing methods with a subsample (158 of 452) of 'known' aged (planted with fin clips) fish.

2. METHODS

2.1 FIELD COLLECTION

Lake trout were obtained during the 1986 winter creel surveys on Big Clear (n=90), Big Rideau (n=88), Big Salmon (n=67), Charleston (n=100), and Devil (n=107) Lakes. Creel survey personnel recorded length, weight, and the origin (planted or native based on the presence/absence of clipped fins) of each fish. Scales, near the dorsal fin, and pectoral fin rays were removed from each fish for ageing.

2.2 LABORATORY ANALYSIS

Lake trout scales and fin rays were allowed to dry before final preparation for ageing. Scales were 'sandwiched' between acetate slides and viewed at 68x magnification using a Realist Vantage microfiche. Fin rays were soaked in bleach for approximately five minutes and cleaned of any fleshy material. Dried fin rays were inserted in a large diameter plastic drinking straw and embedded in clear casting resin. Sections (0.2 to 0.5 mm thick) were cut using a Dremel hobby saw and lightly buffed underwater using #600 sandpaper. Buffed sections were placed in a drop of glycerin and viewed under a compound microscope at 50x magnification. Prepared in this manner, annuli appeared as narrow translucent zones corresponding to the winter season of little growth. Ages were assigned independently to scales and fin rays by one experienced 'reader' (John Tost, consultant).

2.3 DATA ANALYSIS

Data analysis parallelled the statistical treatment used in similar verification studies (Campbell and Babaluk 1979, Mosindy 1982, Belanger and Hogler 1982). The slope of the linear regression of scale (y) versus fin ray (x) age was compared to a slope of one, i.e. x=y (t-test). Paired t-tests (normal distributions) or paired Wilcoxon's non-parametric tests (not normal) were used to test for differences between ages determined by scale and fin ray ageing methods (BBN Software Products Corporation 1984, RS/1 User's Guide).

These analyses were repeated for three age groupings following Ontario (1983): less than 6 years, 6 to 9 years and greater than 9 years of age.

The percent agreement between fin ray and scale aging methods was calculated by age.

Thirty-five percent (158 of 452) of the lake trout used

in this study had fin clips indicating that they were of hatchery origin. Because the pattern of fin-clipping repeats itself every five years, age assignment of stocked fish was based on fork length in combination with fin clip information. Casselman (pers. comm.) has found that this method is not totally reliable for lake trout greater than 500 mm total length. Less than 20% of our stocked fish were of lengths greater than 500 mm, nonetheless, some of our 'known' aged fish may have received incorrect age assignments.

3. RESULTS AND DISCUSSION

3.1 FIN RAY VERSUS SCALE AGES

Regression analysis showed that ages determined using fin rays tended to be greater than scale ages especially for older fish (Figure 3.1). The slope of the regression between fin ray and scale ages was significantly different from one for all age groups except for the <=5 years age group (Table 3.1).

Table 3.1. Regression analysis parameters for fin ray (x) versus scale (y) age.

Fin Ray Age Group (years)	Slope	Intercept	n	Significance	Compare to Slope=1 (t-test)
All Ages	.5152	2.8541	417	p<.0001	p<.001
<=5	.7962	1.5141	83	p<.001	N.S.
6-9	.6603	1.8336	265	p<.0001	p<.001
>=10	.2347	6.2260	69	p<.02	p<.001

Mean (or median) fin ray and scale ages were significantly different for all age groups (Table 3.2). Mean fin ray ages were greater than scale ages except for the age group <=5 years where scale ages were significantly greater. Casselman (pers. comm.) has noted a 'check' on the scales of fish which have recently matured and the lake trout from our study lakes mature at about 5 years of age. In addition, the scale and fin ray 'reader' observed that the outer annuli may have been missing on some fin rays.

The percentage of complete agreement between ageing methods was low at all ages but generally declined with age. Highest percent agreement (46%) occurred at age 6 (Table 3.3). Agreement to +/- one year was high (>80% except at age 4) up to age 6 and agreement to +/- two years was high (>80%) up to age 9. Very poor agreement between ageing methods occurred for lake trout aged ten and older.

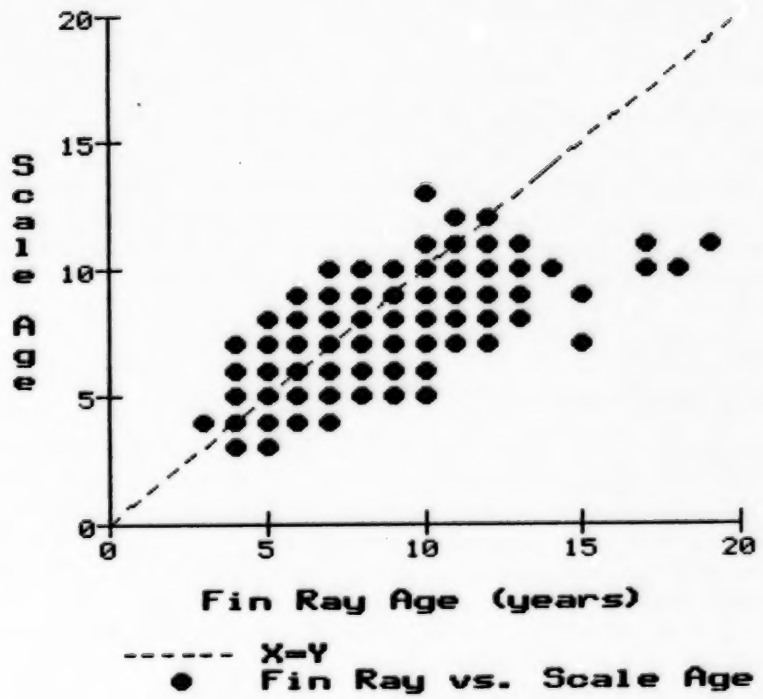

Figure 3.1 Ages assigned using fin rays and scales from 452 lake trout angled from five southeastern Ontario lakes (dots represent one or more data points).

Table 3.2. Mean and median ages for fin ray and scale aged lake trout. Statistical significance for the appropriate test (t-test or Wilcoxon's test) is given.

Fin Ray Age Group	Mean Age Fin Ray	Mean Age Scale	Median Age Fin Ray	Median Age Scale	Significance T-test	Significance Wilcoxon
All Ages	7.26	6.59	7	6	-	p<.001
<=5	4.71	5.27	5	5	-	p<.001
6-9	6.90	6.39	7	6	-	p<.001
>=10	11.70	8.97	10	10	p<.001	-

In summary, agreement between the two ageing methods declined with age; fin rays yielding higher values than scales except for young fish. Further analysis showed similar results when native and planted fish were examined separately.

3.2 FIN RAY AND SCALE AGES VERSUS 'KNOWN' AGES

Regression analysis showed good agreement between fin ray and 'known' ages (see Figure 3.2, Table 3.4). The slope of the line was not significantly different from one for any age group nor for all ages combined. For scale aged lake trout, the slopes were not significantly different from one for any individual age group. However, when all fish were combined, the slope was significantly different from one (Table 3.5).

Mean (or median) ages using fin rays were greater than 'known' aged lake trout (Table 3.6). This has not previously been observed. By contrast, mean (or median) ages using scales were higher than the 'known' age for lake trout <=5 years old, not significantly different for fish >=6 but <=9 years, and lower for those >=10 years (Table 3.7). One hypothesis to explain this finding is that a 'check' on scales at maturation (see above) caused an overestimation for fish of about 5 years of age (age at maturity). The ages of fish older than 10 years were underestimated as scales became inconsistent in their annulus formation. Those fish aged 6 to 9 represented a 'cross-over' point where the two errors cancelled to give an 'accurate' age estimate.

Table 3.3. Cumulative percent agreement between fin ray and scale age of lake trout.

Agreement (+/- n years)	Fin Ray Age Class (years) 3	4	5	6	7	8	9	10	11	12	13
Complete	0	38.9	32.3	46.3	25.0	19.0	19.2	4.3	5.6	9.1	0
+/- 1	100	66.7	80.7	90.9	69.7	61.9	73.0	43.4	33.4	27.3	0
+/- 2		94.5	95.2	98.3	90.8	85.7	88.4	60.8	55.6	54.6	22.2
+/- 3		100	100	100	100	100	96.1	86.9	88.9	72.8	44.4
+/- 4							100	95.6	100	81.9	77.7
+/- 5								100		100	100

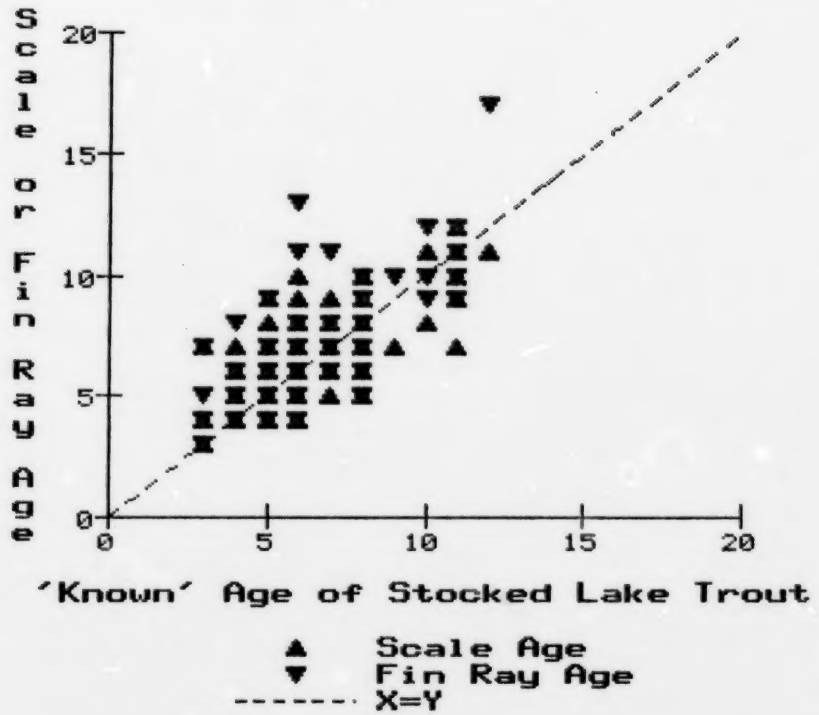

Figure 3.2 Ages assigned using scale or fin rays compared with 'known' ages of 158 stocked lake trout (triangles represented one or more data points).

Table 3.4. Regression analysis parameters for 'known' age versus fin ray age.

'Known' Age Group (years)	Slope	Intercept	n	Significance	Compare to Slope=1 (t-test)
All Ages	.8894	1.2606	155	p<.001	N.S.
<=5	.6279	2.6606	56	p<.005	N.S.
6-9	.7778	1.7778	85	p<.001	N.S.
>=10	2.2353	-12.7353	14	p<.01	N.S.

Table 3.5. Regression analysis parameters for 'known' age versus scale age.

'Known' Age Group (years)	Slope	Intercept	n	Significance	Compare to Slope=1 (t-test)
All Ages	.6282	2.6331	149	p<.001	p<.001
<=5	.9890	1.3096	54	p<.001	N.S.
6-9	.7299	1.7091	82	p<.001	N.S.
>=10	1.1786	-3.0000	13	N.S.	N.S.

Thus, mean or median ages were significantly different from 'known' ages for all age groups except fish >10 years old aged by fin rays and fish 6 to 9 years aged by scales.

The percentage of complete agreement between 'known' age compared to fin ray and scale ages was low. For ages with a sample size of at least ten (ages 5 to 8), the percentage of complete agreement averaged about 38% for fin rays and 26% for scales. Agreement to within +/- one year of 'known' ages was generally better for fin ray ages. For agreement to within +/- two years both methods gave good results at all ages (Tables 3.8 and 3.9).

Table 3.6. Mean and median ages for fin ray and 'known' aged lake trout. Statistical significance for the appropriate test is given.

'Known' Age Group	Mean Age Fin Ray	Mean Age 'Known'	Median Age Fin Ray	Median Age 'Known'	Significance T-test	Significance Wilcoxon
All Ages	6.73	6.15	6	6	-	p<.01
<=5	5.55	4.61	6	5	-	p<.01
6-9	6.76	6.41	6	6	-	p<.05
>=10	11.21	10.71	11	11	N.S.	-

Table 3.7. Mean and median ages for scale and 'known' aged lake trout. Statistical significance for the appropriate test is given.

'Known' Age Group	Mean Age Scale	Mean Age 'Known'	Median Age Scale	Median Age 'Known'	Significance T-test	Significance Wilcoxon
All Ages	6.50	6.16	6	6	-	p<.02
<=5	5.85	4.59	6	5	-	p<.01
6-9	6.43	6.46	6	6	-	N.S.
>=10	9.69	10.76	11	11	p<.02	-

Table 3.8. Cumulative percent agreement between fin ray and 'known' age of lake trout.

Agreement (+/- n years)	Age Class (years) 3	4	5	6	7	8	9	10	11	12
Complete	14.3	37.5	31.7	51.6	16.7	50.0	0	60.0	25.0	0
+/- 1	71.4	50.0	85.4	90.3	91.7	70.0	100	80.0	87.5	0
+/- 2	85.7	87.5	97.6	95.1	91.7	90.0		100	100	0
+/- 3	85.7	87.5	97.6	95.1	91.7	100				0
+/- 4	100	100	100	95.1	100					0
+/- 5				98.3						100
+/- 6				98.3						
+/- 7				100						

Table 3.9. Cumulative percent agreement between scale and 'known' age of lake trout.

Agreement (+/- n years)	Age Class (years) 3	4	5	6	7	8	9	10	11	12
Complete	28.6	12.5	12.8	29.3	36.4	25.0	0	0	37.5	0
+/- 1	85.7	62.5	74.3	74.1	63.7	75.0	0	25.0	62.5	100
+/- 2	85.7	75.0	87.1	94.8	100	91.7	100	100	87.5	
+/- 3	85.7	100	97.4	96.5		100			87.5	
+/- 4	100		100	100					100	

4. CONCLUSION AND RECOMMENDATION

Neither fin rays or scales allowed satisfactory age assessment for all lake trout age groups. However, we conclude that our scale aging method yields acceptable results for the 6 to 9 year old age group. We recommend that, where possible (eg. creel surveys), otiliths be collected in order to obtain more accurate ages for younger and older lake trout (see Swainson 1985).

5. ACKNOWLEDGEMENTS

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